Problem Statement and Goals
RoCam

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Table 1: Revision History

Date	Developer(s)	Change
Sept. 8, 2025	Jianqing Liu	Initial Draft
...	...	...

1 Problem Statement

[You should check your problem statement with the problem statement checklist. —SS]

[You can change the section headings, as long as you include the required information. —SS]

1.1 Problem

In model rocketry, staging fails and parachute tangling has been the hardest engineering problems to solve due to difficulties to observe what actually happens when the rocket is in the air.

Model rockets fly extremely fast and high, some exceeding mach 3 and reach an altitude over 100km (TODO: citation here). This makes manual camera tracking basically impossible.

Tracing a small model rocket can be more challenging than big rockets like the Falcon 9, because the launch pad environment is more unpredictable and the target is smaller, which makes it harder to identify and track.

Some commercial tracking camera solutions exist (TODO: citation here), but they do not have the performance and accuracy required to track a small and fast accelerating model rocket.

This project aims to develop a production-ready software stack for the tracking camera with a modular interface for the gimbal mechanism.

1.2 Inputs and Outputs

[Characterize the problem in terms of "high level" inputs and outputs. Use abstraction so that you can avoid details. —SS]

- Inputs
  - 1080p 60fps camera feed
- Outputs
  - Gimbal movement commands
  - Real-time 1080p 60fps digitally zoomed and stablized video feed
  - Web management portal

1.3 Stakeholders

- Model Rocket Engineers

1.4 Environment

[Hardware and software environment —SS]

1.5 Gimbal

An off-the-shelf cheap gimbal is used.

A custom developed PCB is used to adapt the gimbal to the Jetson.

1.6 Computer Vision

Nvidia Jetson Orin Nano Super

1.7 Web Management Portal

Runs on any recent web browser

2 Goals

Track small-scale rocket launches (apogee ¡ 200m)

3 Stretch Goals

connected to a full-size gimbal developed by the McMaster Rocketry Team to track high-powered rocket launches (apogee 3km+)

4 Extras

[Teams may wish to include extras as either potential bonus grades, or to make up for a less advanced challenge level. Potential extras include usability testing, code walkthroughs, user documentation, formal proof, GenderMag personas, Design Thinking, etc. Normally the maximum number of extras will be two. Approval of the extras will be part of the discussion with the instructor for approving the project. The extras, with the approval (or request) of the instructor, can be modified over the course of the term. —SS]

4.1 Circuit Design

4.2 TODO: Extra 2

Appendix — Reflection

[Not required for CAS 741 —SS]

The purpose of reflection questions is to give you a chance to assess your own learning and that of your group as a whole, and to find ways to improve in the future. Reflection is an important part of the learning process. Reflection is also an essential component of a successful software development process.

Reflections are most interesting and useful when they're honest, even if the stories they tell are imperfect. You will be marked based on your depth of thought and analysis, and not based on the content of the reflections themselves. Thus, for full marks we encourage you to answer openly and honestly and to avoid simply writing "what you think the evaluator wants to hear."

Please answer the following questions. Some questions can be answered on the team level, but where appropriate, each team member should write their own response:

1. What went well while writing this deliverable?
2. What pain points did you experience during this deliverable, and how did you resolve them?
3. How did you and your team adjust the scope of your goals to ensure they are suitable for a Capstone project (not overly ambitious but also of appropriate complexity for a senior design project)?